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Pollution Prevention: A Guide to Program Implementation

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Pollution Prevention: A Guide to Program Implementation

Illinois Waste Management and Research Center
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February 11, 1993

To Pollution Prevention Planning Guide Users:

The Hazardous Waste Research and Information Center (HWRIC) is pleased you have obtained its guide for the development of a facility pollution prevention program and plan. We believe the evidence is overwhelming that once companies participate in a pollution prevention opportunities assessment and develop a pollution prevention program and written plan, they will not only reduce their waste and emissions, but will also save money.

"Pollution Prevention: A Guide to Program Implementation" is based in part on manuals prepared by EPA and by a number of state pollution prevention programs. We have tried to tailor it, based on our experiences with a variety of industrial facilities, to meet the needs of Illinois industries. It can and probably should be used in conjunction with the new USEPA manual, "Facility Pollution Prevention Guide," published in May 1992. The EPA manual provides more detailed information and can serve as a good reference when additional background is needed on any particular aspect of pollution prevention planning.

We hope that this guide can serve as a simple manual for pollution prevention planning. We realize that not every company will utilize every element of this document, and that each will have to tailor the suggestions or recommendations made in the manual to their particular needs. Each company should seek ways of integrating pollution prevention concepts into the way they do business. In other words, pollution prevention should not be an add-on program, but rather a part of existing programs that produce a quality product, protect workers and the environment, and meet regulatory requirements.

Development of this guide has been made possible through state funds and also, in part, through a Pollution Prevention Incentives to States Grant from USEPA. We hope you will read this manual and implement pollution prevention in your facility. I'm convinced that your efforts to develop a pollution prevention program and plan will pay off for you in a variety of ways, as it is doing today for numerous companies throughout the country. If we can provide assistance in any way, I hope you will call on us.

David L. Thomas, Ph.D.
Director

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INTRODUCTION

1

Industrial waste generation in the United States has reached daily averages in the billions of pounds. In Illinois alone, the quantity of Resource Conservation and Recovery Act (RCRA) designated hazardous waste totaled 6.2 million tons for 1990 (IEPA, 1992). Toxic chemicals released by 1,305 Illinois facilities reporting under the Superfund Amendments and Reauthorization Act (SARA) totalled 233 million pounds for 1990 (IEPA, 1992). Almost 88.1 million pounds were air releases through stacks or fugitive emissions statewide; while 66.1 million pounds came from facilities in Cook County. The total non-hazardous solid waste disposed in Illinois during 1991 was 41.6 million cubic yards (IEPA, 1991).

This waste discharged to our air, water or land represents a significant loss of raw materials and a potential threat to human health and the environment. To be responsible guardians of environmental quality, waste generators must review their production processes and operations as well as consider both the economic and the environmental benefits of implementing a pollution prevention program.

Adopting a pollution prevention program as a way of doing business can provide a number of significant benefits to a company. By decreasing the amount of waste generated or released, a company can reduce waste disposal costs, improve worker safety, and reduce long-term liability. In addition, pollution pre-

POLLUTION PREVENTION
WHAT: Pollution Prevention – any in-plant practice that reduces or eliminates the amount and/or toxicity of pollutants which would have entered any waste stream or would otherwise have been released into the environment prior to management techniques such as recycling, treatment or disposal. It includes the design of products and processes that will lead to less waste being produced by the manufacturer or the end user.
WHO: Any business that – • generates waste • uses hazardous materials • emits or discharges waste into the air, water or land • wants to save money through reducing waste handling costs, raw material costs and production costs • wants to operate in an environmentally sound and responsible manner
WHY: Businesses that implement a pollution prevention program – • avoid rising costs of waste disposal • save money in other areas such as purchasing of raw materials • increase their industrial efficiency • maintain or increase competitiveness • decrease long-term liability • follow state and federal policy guidelines • may reduce present and future regulatory burdens • improve environmental and workplace conditions • ensure community safety • maintain good corporate image

Table 1. An Introduction to Pollution Prevention

vention methods may increase the efficiency of the production line and decrease costs associated with the purchase of raw materials, inventory control, etc. Any resulting changes in efficiency or expenditures may help the company to retain or improve its competitiveness in the marketplace.

Companies have traditionally evaluated their industrial processes in terms of optimizing their production, but times have changed. Due to increasing environmental concerns associated with industrial waste, companies must now incorporate waste management and prevention strategies into their industrial processes. Companies must reexamine their production lines with the goal of reducing waste generation. By increasing efficiency of operation, companies can see that more of their raw materials go into products rather than ending up as waste.

Properly managing or treating waste for disposal is not considered pollution prevention. Rather than focusing on end-of-pipe technologies and treatments, companies should implement a pollution prevention strategy that begins with materials selection and purchase before they arrive at the receiving dock. From a materials management point of view, pollution prevention is not only a strategy to use safer raw materials, but also to ensure more efficient use of these materials.

POLLUTION PREVENTION
IS
Source reduction
In-process recycling
Clean technology
Raw material substitution
Preventive maintenance
IS NOT
End-of-pipe technologies
Pollution control
Off-site waste recycling
Out-of-process waste recycling

Table 2. The Pollution Prevention Concept

How to Use This Manual

This manual serves as an overview for Illinois businesses of all sizes that have chosen to learn more about developing a pollution prevention program. The manual is organized into 15 chapters and an appendix.

The Hazardous Waste Research and Information Center has followed the basic six-step outline of the U.S. Environmental Protection Agency's *Draft Guidance to Hazardous Waste Generators of the Elements of a Waste Minimization Program.* However, based on experience gained while assisting companies with developing pollution prevention programs, the steps have been restructured and expanded to ensure development of successful pollution prevention programs.

Additional sources to consult for more detailed coverage, worksheets, and resources on pollution prevention are EPA's new publication, *Facility Pollution Prevention Guide (1992)* EPA/600/R-92/088 and *Pollution Prevention Resource and Training Opportunities in 1992* EPA/560/8-92-002.

Information in this manual must be customized as needed to make it applicable to the specific sizes and types of industrial processes used at your facility. What works at one plant may not be feasible at another due to technical, regulatory, or economic constraints.

The order of the chapters follows the progression of activities needed to implement a pollution prevention program. By nature, a pollution prevention program is continuous – project implementation leads to feedback and redefinition of goals for additional projects, and so on. Chapters 2-4 provide basic information on terms, pollution prevention rewards and problems, and federal and state legislative background. Chapter 5 provides an overview of the steps for developing a pollution prevention program; Chapters 6-13 describe these steps in detail. The closing chapters, 14 and 15, discuss other waste management options and provide resources for pollution prevention technical assistance in Illinois.

DEFINITION OF TERMS

2

Throughout this manual, we will be using terms that may have been used interchangeably in the past. The following brief definitions will help to clarify these concepts.

Pollution prevention - any in-plant practice that reduces or eliminates production of pollutants or prevents them from entering any waste stream or otherwise being released into the environment prior to recycling, treatment or disposal.

A pollution prevention program should focus on source reduction and in-process recycling. This recommendation follows the definition used in the Federal Pollution Prevention Act of 1990 and the Illinois Toxic Pollution Prevention Act of 1989. However, other waste management strategies, not considered to be pollution prevention, such as off-site recycling, treatment, and proper disposal methods should also be addressed in the company's comprehensive waste management plan (see Chapter 14).

Source reduction - any practice which reduces the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal and reduces the hazards to public health and the environment associated with the release of such substances, pollutants or contaminants. The term includes: equipment or technology modifications; process or procedure modifications; reformulation or redesign of products; substitution of raw materials; and improvements in operating procedures, maintenance, training or inventory control.

In-Process Recycling - direct use, reuse, or reclamation of waste material within a process.

Waste minimization - this term is generally used to refer to activities that involve Resource Conservation and Recovery Act (RCRA) hazardous waste only. It may include source reduction and environmentally sound recycling in any form including off-site recycling and beneficial re-use. This term does not include treating or disposing of waste after it has been created.

Additional definitions that may be of use include:

Wastes – pollutant discharges, off-spec products, non-commercial co-products or by-products, and substances that receive destructive or containment treatment and disposal.

Hazardous materials/waste – any material /waste which is RCRA listed or which is hazardous due to one or more of the following characteristics: 1) toxicity (poison); 2) flammability/combustibility; 3) corrosivity; and, 4) chemical reactivity.

Special wastes – An Illinois-specific designation for any non-RCRA industrial process waste or pollution control waste which has not been declassified.

Toxic – Relating to a harmful effect by a substance on living organisms through physical contact, ingestion, or inhalation.

INCENTIVES AND OBSTACLES FOR POLLUTION PREVENTION

3

Pollution prevention is often referred to as business planning with environmental benefits. The most common benefits and incentives for establishing a pollution prevention program are presented here. Some of the obstacles that may hinder implementation or program development are also discussed.

Incentives

Reduced Operating Costs (Economics) – Pollution prevention activities usually save a company money in the long term. Many pollution prevention projects have good returns on investment and short payback periods. Money is usually saved in disposal costs, new material costs and improved operating efficiency. Many firms report that the majority of savings comes from the latter.

Improved Worker Safety – Reduction of the use of toxics in the workplace is a major aspect of pollution prevention. By reducing or eliminating toxic substance use, the safety of the work environment can be improved and personal protective equipment requirements decreased. Also, reducing the likelihood of leaks, spills and releases can decrease worker, visitor, and contractor exposure. These steps will result in cost savings through preventing the loss of materials and possibly through decreased insurance rates by reducing medical claims and disability leave. Better labor relations can also result from improved worker safety.

Reduced Compliance Costs – Undertaking pollution prevention projects can reduce your regulatory exposure and, in some cases, may eliminate the need for permits, manifesting, monitoring and reporting. Keeping up with regulatory requirements and submitting the required reports is an expensive and time consuming process which, if eliminated, saves money.

Increased Productivity – Pollution prevention can improve plant productivity through more efficient use of raw materials due to improved processes and operations. Many industrial plants that produce large quantities of wastes may be using old technologies to make their products, or their processes may be poorly controlled and inefficiently operated. Sometimes small improvements can result in increased product yield and better quality.

Increased Environmental Protection – Many waste disposal and treatment methods have been shown to be less protective of the environment than previously estimated. These methods may just move environmental contaminants from one medium to another. They may cause future problems that are not yet apparent. Pollution prevention reduces the generation of wastes at the source, or results in less toxic waste, and thus assures improved environmental protection.

Reduced Exposure to Future Liability Costs – Reduction of potential long term liability from waste disposal has become an important concern in recent years. Past disposal practices, even though they may have been legal, have often caused environmental damage that has proved to be expensive for industrial facilities as well as damaging to their public image. Pollution prevention can help to reduce long term liability by reducing the amount and the hazard of waste generated.

Continuous Improvement – Successful implementation of a pollution prevention program can be an integral part of a company's continuous improvement or Total Quality Management program. Reducing wastes and improving efficiency are what both pollution prevention and continuous improvement are all about.

Obstacles

Capital Requirements – Implementation of many pollution prevention measures often requires capital investment. Such projects may need to be justified on an economic basis.

Specifications – Specifications can be both an incentive and an impediment. For instance, government contracts may specify certain materials be used in the manufacture of a product or that virgin materials be used rather than recycled materials. This can lead to the use of materials that are damaging to the environment or the unnecessary use of virgin materials where recycled materials would suffice.

Regulatory Issues – It may be necessary to obtain a new or modified permit, or other governmental approval, before implementing a process change or material substitution. This can be time consuming and costly. For example, if a process is regulated by the Food and Drug Administration (FDA), all process changes require submittal of an application for approval and new equipment must be inspected and approved by the FDA. In some cases, clinical trials of a substance, such as a drug, must be repreated to demonstrate efficacy.

Product Quality Issues– Companies have great concern for the quality of the products they manufacture. Some pollution prevention projects may change product quality, even when properly implemented, and thus may be regarded with skepticism.

Customers' Acceptance – The customer ultimately defines product quality; anything that affects the quality, or even the perception of its quality, may affect acceptance by the customer.

Immediate Production Concerns– Implementation of pollution prevention projects may often require time, money, and personnel, all of which are usually in short supply.

Company Image Concerns –- Often companies are hesitant to admit that the "old way" may not have been the best way. Once easy to implement pollution prevention practices such as improved operations, for example, are underway, companies may realize that they could have been doing it all along but do not want the fact made public because it may make them look bad.

Available Time/Technical Expertise – Some organizations may lack sufficient time or technical espertise to develop and implement pollution prevention practices.

Inertia – Whenever a production system is in place and working with some degree of success, there is a tendency to leave well enough alone. The old adage "If it isn't broke, don't fix it," applies.

Although there may be many obstacles to implementing pollution prevention, the benefits can be so great as to warrant working through the obstacles. By properly educating and including *all* employees, as well as customers and suppliers, on the advantages and stages of a pollution prevention program, successful projects and programs can be achieved.

FEDERAL AND STATE LEGISLATIVE OVERVIEW

4

This chapter provides an overview of recent policy decisions on both the federal and state levels that concern pollution prevention measures.

LEGISLATIVE DEFINITIONS

Federal	State
"The Congress hereby declares it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner." From the Pollution Prevention Act of 1990	"It is the purpose of this Act to reduce the disposal and release of toxic substances which may have adverse and serious health and environmental effects, to promote toxic pollution prevention as the preferred means for achieving compliance with environmental laws and regulations . . . However, 'toxic pollution prevention' shall not include or in any way be inferred to promote or require incineration, transfer from one medium of release to another, off-site or out of process waste recycling, or end of pipe treatment of toxic substances." From the Illinois Toxic Pollution Prevention Act of 1989

Table 3. National and State Pollution Prevention Definitions

Federal Legislative Background

The shift in focus from pollution control (treatment and disposal) to waste reduction/ pollution prevention began in 1976 with the Resource Conservation and Recovery Act (RCRA). RCRA identified reducing waste at the source as the most desirable waste management option. With the passage of the Hazardous and Solid Waste Amendments (HSWA) in 1984, regulations required the generators of hazardous waste to submit a biennial report summarizing their efforts to reduce the volume and toxicity of waste generated. HWSA also requires generators who ship their waste off site to certify that they have a program in place to reduce the volume and quantity of these wastes to the degree determined by the generator to be economically and technically practical.

Until very recently most government programs have emphasized control of wastes after they are produced. The policy shift is reflected in the excerpt from the Pollution Prevention Act of 1990 presented above. The Act states that each owner or operator of a facility required to file an annual toxic chemical release form under section 313 of the Superfund Amendments and Reauthorization Act (SARA) shall include with each filing a toxic chemical source reduction and recycling report for the

preceding calendar year. This requirement became effective in 1992. The reporting requirements include the following:

1. the quantity of the chemical entering any waste stream or otherwise released to the environment;

2. the amount of the chemical which is recycled in a calendar year, including the percentage change from the previous year;

3. source reduction practices used with respect to that chemical during the year (this includes a variety of technologies and techniques such as improvement in management, training, inventory control, materials handling, or other general operational phases of industrial facilities);

4. projections of expected releases for the next two reporting years;

5. a ratio of production in the reporting year to production in the previous year; and,

6. techniques which were used to identify source reduction opportunities (such as employee recommendations, external and internal audits, participative team management, and material balance audits).

Although there are other requirements, these six provide an overview of the scope of information being requested by the Act. Point 6 above lists a number of items that are important components of a Pollution Prevention Plan, and although not required, it is obvious that planning by industry is desired and will be necessary to fully comply with the regulations.

The USEPA has developed three programs to encourage the use of pollution prevention techniques, among other methods, to reduce toxic releases. EPA's 33/50 Program is a voluntary program to reduce national pollution releases and off-site transfers of 17 toxic chemicals by 33 percent by the end of 1992 and by 50 percent by the end of 1995. The Green Lights program sponsored by USEPA encourages companies to decrease their energy use by using more energ efficient lighting, which, in turn, reduces the amount of waste generated through the generation of power. The third program is the Early Reduction Program under the Clean Air Act (CAA). The air toxics provisions of the CAA amendments (Title III - Section 112 (i)) offer sources a 6 year extension to achieve compliance in exchange for early reductions of toxic air emissions. Sources which achieve a 90 percent (95 percent for particulates) reduction in the amount of listed hazardous air pollutants prior to EPA's proposed relevant maximum achievable control technology (MACT) standard may be eligible for this compliance extension.

RCRA reauthorization (both subtitle C and D) will probably contain detailed information about the components of a pollution prevention program and will certainly be specific with regard to reporting requirements. Reauthorization of RCRA is not likely to occur before 1993, and specific guidance on subtitle D will occur even later. The Clean Water Act reauthorization may also include a pollution prevention provision.

It is clear that as the federal government moves toward eliminating or reducing pollution at the source, and examines permitting on a multi-media and facility wide basis, industry will be forced to develop comprehensive pollution prevention programs which address the flow of all materials through the plant and the generation of all waste.

State Legislative Background

In Illinois, pollution prevention has been encouraged through passage of both the Toxic Pollution Prevention Act (TPPA) in 1989, the Solid Waste Management Act and the Illinois Pollution Prevention Act. TPPA was intended to encourage pollution prevention throughout the state by establishing duties for both the Hazardous Waste Research and Information Center (HWRIC) and the Illinois Environmental Protection Agency (IEPA).

As mandated in TPPA, HWRIC established a toxic pollution prevention assistance program to provide information and guidance to Illinois businesses who wish to develop pollution prevention programs. These assistance efforts are on-going and include seminars, curriculum development, research, on-site con-

sultation, and pilot pollution prevention projects.

The TPPA also established a toxic pollution prevention program within IEPA. The Office of Pollution Prevention in IEPA conducts a number of activities including the Partners in Pollution Prevention Program (PIPP). This program is intended to enlist private firms in voluntary pollution prevention activities. Partner facilities are "rewarded" for their efforts by receiving expedited permit reviews and other assistance. Another IEPA program places graduate engineering students in industrial firms as interns to conduct pollution prevention related projects.

Amendments to TPPA have been proposed that would make the establishment of pollution prevention activities in industrial facilities mandatory and subject to state guidelines. No such amendments have passed in Illinois, but such laws do exist in several other states. Mandatory planning may become a federal requirement in future years.

The Illinois Solid Waste Management Act is another legislative mandate which focuses on pollution and wastes. It states, "It is the purpose of this Act to reduce reliance on land disposal of solid waste, and to assist local governments with solid waste planning and management. In furtherance of those aims, while recognizing that landfills will continue to be necessary, this Act establishes the following waste management hierarchy, in descending order of preference, as State policy:

1) volume reduction at the source;
2) recycling and reuse;
3) combustion with energy recovery;
4) combustion for volume reduction;
5) disposal at landfill facilities."

This hierarchy is intended to recognize that waste management should be approached in a progressive manner, choosing the most environmentally protective alternative first, and the least protective last. Although this statement refers specifically to solid waste, the same general approach is also implicit in the approaches taken for other media in both the federal and state pollution prevention acts.

The Illinois Pollution Prevention Act (1992) establishes a hierarchy of the most desirable waste and pollution management options. They are:

1) pollution should be prevented or reduced at the source whenever feasible;
2) when source reduction is not feasible, recycling in an environmentally safe manner should be utilized;
3) when neither source reduction nor recycling are feasible, treatment in an environmentally safe manner should be utilized;
4) when treatment is not feasible, only as a last resort should disposal or other release into the environment in an environmentally safe manner be utilized.

In addition, the Illinois Pollution Prevention Act establishes a Pollution Prevention Advisory Council. This group will be composed of members from state government, industry, environmental groups, and private citizens. It is intended to advise Illinois government and industry on courses of action that can be taken to encourage pollution prevention. The act also requires that IEPA produce an annual pollution prevention progress report utilizing SARA 313 TRI and RCRA generator report data.

As can be seen by the recent actions taken at both the federal and state levels, pollution prevention is a concept that is new and continuing to develop. Requirements for industry to establish a pollution prevention program in their facilities may be required in the future.

DEVELOPING A POLLUTION PREVENTION PROGRAM

5

There is often general confusion among the terms pollution prevention program, plan and project. Many companies have compiled a list of projects and called the list a plan – such a list is not a plan. A pollution prevention **program** involves developing and implementing a continuous strategy to address all waste generated by a facility and procedures for prioritizing and systematically reducing these wastes. A pollution prevention **plan** is a written guide used to chart the progress of the program. It reiterates management support, lists reasons for the program, identifies the pollution prevention team, describes how waste will be characterized, provides a strategy and schedule for pollution prevention assessments, institutes a cost allocation system, indicates how technology transfer will take place, addresses training needs, and discusses how the program and projects will be evaluated and implemented. The plan needs to be periodically updated to reflect the continuous nature of a pollution prevention program. **Projects** are the specific activities undertaken to reduce or eliminate waste.

In the chapters that follow, the steps to establish and maintain a pollution prevention program will be presented. These steps, as illustrated in Fig. 1, include:

1. Obtaining support from top management.

2. Getting the program started by beginning to incorporate the process within the company, developing a written pollution prevention plan, and training employees in pollution prevention.

3. Reviewing and describing in detail the manufacturing processes within the facility to determine the sources of waste generation and to define a baseline inventory to be used to set goals and evaluate progress.

4. Identifying potential pollution prevention opportunities for the facility.

5. Determining cost of current waste generation and establishing a system of proportional waste management charges for those departments that generate waste.

6. Selecting the best pollution prevention options for the company and implementing these choices.

7. Evaluating the pollution prevention program on a company-wide basis as well as evaluating specific pollution prevention projects.

8. Maintaining and sustaining the pollution prevention program for continued growth and continued benefits to the company. Re-evaluating the program as economic situations change and/or process equipment require upgrading.

The concepts presented in this manual are applicable to the reduction of all waste regardless of media, quantity or toxicity. Some interpretation may be needed to make the suggestion usable by your specific industry and facility.

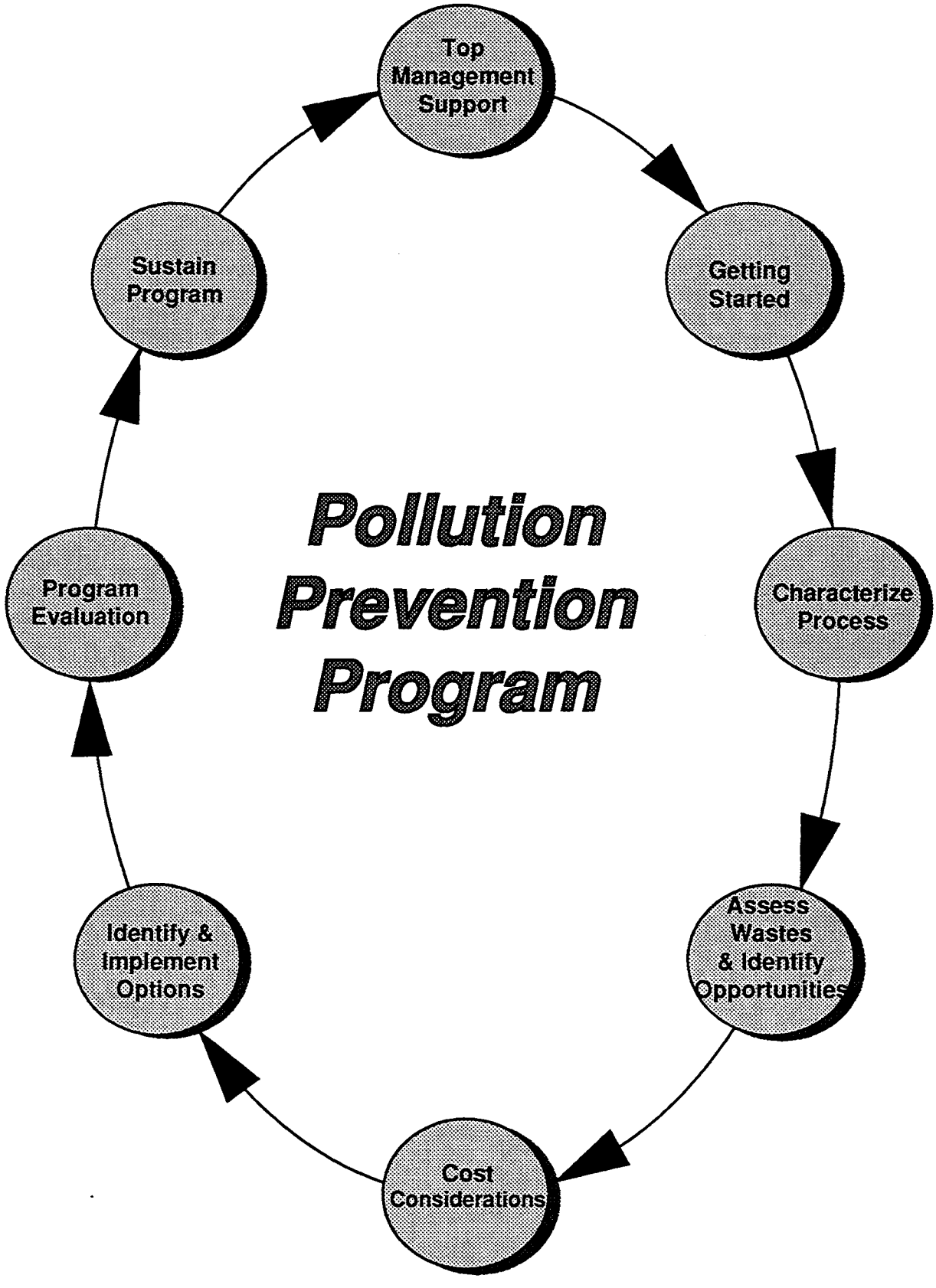

Fig. 1. The Pollution Prevention Loop

TOP MANAGEMENT SUPPORT

6

Top management support is needed to get a pollution prevention program started, to incorporate it into already existing activities, and to sustain it. You may be using your own initiative to learn more about pollution prevention or you may have been given this responsibility by supervisors. To begin a successful pollution prevention program, draft a brief written policy statement in support of a pollution prevention program. Obtain endorsement of the policy by all management levels and then distribute to all employees. In some cases, developing a corporate-wide policy statement can be a lengthy process. Rather than allow this procedure to delay proceeding with the program, an interim policy or area-specific policy can be developed. This can get the program started; the corporate policy can follow later. Several examples of management policy statements are provided in Fig. 2.

Suggestions on how to garner the support of all levels of management include providing them with information on some of the benefits of implementing a pollution prevention program. Include the following topics:

- cost savings through reduced raw material usage and waste, handling, transportation and storage costs
- increased productivity
- improved product quality
- regulatory compliance
- worker health and safety
- reduction of potential long-term liability
- examples of what other similar companies have achieved
- improved public/corporate image

Additional support needed from management includes: assigning responsibility for progress evaluation, allocating time and budget, and recognizing achievements. Continuity of the pollution prevention program is important. It should be set up in such a way that one step can flow naturally into the following step in a continuous cycle.

It may be necessary to get top management levels interested in developing a pollution prevention program. To increase their knowledge about the subject, bring to their attention case studies from other successful companies. Bring in outside speakers to talk about benefits of developing pollution prevention programs. If the company already has some pollution prevention activities underway, apply for the Governor's Pollution Prevention Awards program in Illinois. Just the act of applying for this award can result in more commitment from top management.

A pollution prevention program needs to be viewed by all personnel in the facility as a way of doing business. It can be incorporated within a total quality management (TQM) program because it focuses on increasing efficiencies and more effectively utilizing raw materials. It also builds nicely on a health or environmental safety program because it can do the following: reduce the amount/toxicity of chemicals in the workplace; reduce short and long-term exposure of empolyees, visitors, and contractors; reduce or eliminate monitoring requirements; reduce HVAC requirements; and, reduce or eliminate need for personal protective equipment.

SAMPLE ONE

MANAGEMENT POLICY STATEMENT

We, [company name], are committed to excellence and leadership in protecting the environment. In keeping with this policy, our objective is to reduce waste generation and emissions. We strive to minimize adverse impact on the air, water, and land through excellence in pollution prevention. By successfully preventing pollution at its source, we can achieve cost savings, increase operational efficiencies, improve the quality of our products and services, and maintain a safe and healthy work place for our employees.

[Company name]'s environmental guidelines include the following:

- Environmental protection is everyone's responsibility. It is valued and displays commitment to [company name].

- Preventing pollution by reducing and eliminating the generation of waste and emissions at the source is a prime consideration in research, process design, and plant operations. [Company name] is committed to identifying and implementing pollution prevention opportunities through encouragement and involvement of all employees.

- Technologies and techniques which substitute non-hazardous materials and utilize other source reduction approaches will be given top priority in addressing all environmental issues.

- [Company name] seeks to demonstrate its corporate citizenship by adhering to all environmental regulations. We promote cooperation and coordination between industry, government, and the public toward the shared goal of preventing pollution at its source.

(From Minnesota Office of Waste Management, 1991).

SAMPLE TWO

MANAGEMENT POLICY STATEMENT

At [company name], protecting the environment is a high priority. We pledge to eliminate or reduce, wherever possible: 1) our use of toxic substances, 2) our release of toxic pollutants, and 3) our generation of hazardous and other wastes.

When use of toxic substances, generation of wastes, or releases cannot be avoided, we are committed to minimizing any undesirable impacts on the air, water, and land.

(Derived from Minnesota Office of Waste Management, 1991).

Fig. 2. Sample Corporate Pollution Prevention Policy Statements

GETTING YOUR PROGRAM STARTED 7

This chapter outlines a method to incorporate a pollution prevention program into the daily company activities. The steps involved include: committing to implementation, designating a pollution prevention coordinator, developing a pollution prevention team, increasing employee awareness and involvement, rewarding and training employees, goal setting, and developing a written pollution prevention plan.

Commit to Implementation

The commitment from all employees to implement a pollution prevention program starts before any assessment or evaluations have been performed. It is measured as the time and effort needed to raise employee awareness, establish a cohesive pollution prevention team, and begin to incorporate pollution prevention ideas into the day-to-day operations of the company. Pollution prevention is a team effort. The people who enter the facility every day are the most valuable assets to ensure a pollution prevention program works well.

Designate a Pollution Prevention Coordinator

While a pollution prevention program needs top down support and commitment, it also needs bottom up input and implementation. This means teamwork and participation from all levels within the company are essential. A key element for success is to find a good advocate and leader for the pollution prevention program.

The pollution prevention coordinator will be responsible for establishing the pollution prevention team(s), conducting meetings, and making sure the company is working toward its pollution prevention goals. More than likely, the coordinator will come from a mid-management position. He or she needs to be well organized, an advocate for the program, a cheerleader, and a motivator of people. If the coordinator has top management support and the confidence of supervisors and others on the team, he or she will likely develop a very successful program.

The coordinator will act as the key liaison to top management. This helps to ensure that the best pollution prevention ideas in terms of need, feasibility, and benefit to the company are delivered to top management for consideration. Also, the coordinator will need to obtain interdepartmental cooperation and resources on a continuing basis.

Develop a Pollution Prevention Team

A pollution prevention team needs to be organized prior to beginning the assessment process. These responsibilities should not be assigned to any one department. Some suggested key personnel to consider including are: representatives (both supervisors and line workers) from maintenance, production, environmental, health and safety, purchasing, shipping and receiving, legal and engineering departments; and, plant and executive managers. Not every company will have these designations. It is important to include those individuals knowledgeable about the processes generating wastes and involve them from the beginning.

In addition to those individuals assigned duties on the pollution prevention team, others may wish to help. Do not turn away volunteers – everyone should be encouraged to participate in the pollution prevention program. All volunteers should be commended in some way (the in-house newsletter, etc.) for their interest in helping the company, their co-workers, and the environment.

One important point to continually stress throughout the development and implementation of the pollution prevention program is the need to work together. Employee suggestions should continually be encouraged – supervi-

sors need to listen carefully because innovative ideas can come from any employee. Pollution prevention must continue for the life of the facility; establishing a sound, cooperative program from the start will be beneficial in future years.

The initial pollution prevention team meeting should be an informal session to discuss what pollution prevention is, why the company should do it, and where and how to begin. General information about the company's processes and operational procedures should be reviewed. The team will be responsible for developing a formal pollution prevention plan as outlined later in this chapter.

Set Goals

There are different types of goals a company should set when beginning their pollution prevention program. Some goals will be waste specific, while others will be activity oriented. The team should discuss what types of goals are appropriate for the company. For example, a company may want to set an ultimate goal of zero percent waste generation to acknowledge the fact that pollution prevention is a continuing challenge. This is very similar to company goals like "zero product defects" or "zero lost workdays". Another goal may be to replace some or all toxic substances used with nontoxic substances and thus reduce risk to employees, the public, and the environment. Numerical goals for waste reduction may be established once the wastes are characterized.

In addition to specific goals targeted at source reduction, more general goals should also be set. These could include improving worker health and safety in the facility or improving the company image and attractiveness to investors. Activity goals could include incorporating pollution prevention into performance evaluations of all management staff, installing a revised accounting system that charges the cost back to the production line generating the waste, training all employees in pollution prevention, or holding monthly team meetings.

Goals should be continually updated as they are achieved. This is the concept of continuous quality improvement and is an important component of a pollution prevention program. Do not remain static. Build on the successes achieved. Specific goals will vary over time and should be based on the size of the facility and the type of production processes undergoing change. It is a good idea to set a number of measurable goals to track progress within a given period.

Increase Employee Awareness and Involvement

One method of increasing pollution prevention knowledge is through a corporate/facility awareness program. Supervisors should discuss the status of the pollution prevention program at weekly meetings. They should encourage the employees to bring pollution prevention ideas to them so they can forward them on for the facility pollution prevention team meetings. Some companies may already have "quality circles" in place to improve product quality and production efficiency. The team should work with these groups to develop ideas for pollution prevention initiatives. The pollution prevention team should include the following aspects in developing their awareness program:

- provide a definition and explanation of the primary components of pollution prevention – source reduction and in-process recycling
- state company policies and guidelines clearly
- identify company goals to reduce waste generation and to improve operations
- stress that pollution prevention is not only essential but also beneficial
- encourage employee participation as extremely important to improve facility and environmental conditions
- make management and pollution prevention team members available to employee suggestions and new ideas
- present facts on safety improvement that occurs when a pollution prevention program is implemented

- stress the relationship between the cost of generating waste to company competitiveness

- equate savings from pollution prevention with the company's fiscal health (i.e., increasing job security to encourage employee involvement

Train Employees

Specialized pollution prevention training programs tailored for management, line, and maintenance staff should be incorporated into company procedures. Consolidated training for different groups can also stimulate discussion between employees who would not interact otherwise. Additional personnel training may be needed if materials handling or accounting changes are made. The facility or company may want to include a pollution prevention orientation program for all new employees, regardless of their job function. Employees will need thorough training on any new technologies or techniques added to unit processes. Depending upon the size of the facility, this may require training on more than one shift.

Another option is to have performance evaluation systems reflect pollution prevention responsibilities. As pollution prevention strategies are identified, the training requirements must be considered by the pollution prevention team prior to implementation.

Reward Pollution Prevention Successes

To stimulate additional interest and participation in pollution prevention, establish an employee incentive award or recognition program for the facility or company. Competition in larger plants may motivate participation. Shifts, departments, or even individuals can be encouraged to compete against their own past year's performance. Recognition in the form of an awards ceremony, a bonus, a special parking place, or added vacation time, provides a tangible reward to individuals and departments who have achieved their pollution prevention goals. Further recognition may be promoted in a regular pollution prevention column in the company newsletter which recognizes pollution prevention efforts and successes. When a company newsletter is not available, a short one page fact sheet on pollution prevention could be started that acknowledges employee participation and accomplishments.

Develop a Written Pollution Prevention Plan

After the pollution prevention team has been organized, developing a written plan should be the first official task of the pollution prevention team. This plan should include all the ideas developed by the team such as the statement of support from management; the pollution prevention team's structure, organizational guidelines, and statement of purpose; the methods for fostering participation by all employees; the company's general goals; the structure of an incentive/reward program; the procedures, criteria and schedule for implementing pollution prevention projects; and the provisions for employee training.

This plan should be presented and agreed to by management so that they understand how the pollution prevention team will proceed and what resources/support will be required from them. The plan should be modified on an annual basis as pollution prevention experience is gained and goals are reached. A company should strive to continually improve the entire program.

UNDERSTANDING PROCESSES AND WASTES

8

To effectively implement a pollution prevention program, it is important to understand the various unit processes and where in these processes waste is being produced. This chapter will explain how to determine the various unit process steps in materials use and will present methods to determine where wastes are being generated. An extensive amount of data gathering may be necessary in this step in order to achieve a complete process characterization.

Two general approaches characterizing processes and waste generation are used. One method begins with gathering information on total multi-media (air, land, and water) waste releases at the end of each process, and then backtracks to determine waste sources. Another method tracks materials from the point at which they enter the plant until they exit as wastes or products. Both methods provide a baseline for understanding where and why wastes are generated and a basis to measure waste reduced after implementation of pollution prevention projects. The steps involved in these characterizations include gathering background information, defining a production unit, general process characterization, understanding unit processes, and completing a material balance.

Gathering Background Information

The first step toward understanding processes and waste generation is gathering background information on the facility. This allows for the accurate determination of the type and quantity of raw materials used, the type and quantity of wastes generated, the individual production mechanisms, and the interrelationships between the unit processes. The pollution prevention team should divide up the responsibilities for obtaining this information. A time frame should be established for assembling the data and presenting it to the group. Table 4 provides suggestions on data that should be assembled and where this information might be found.

In addition to these data, useful information can be obtained from line workers, maintenance staff, process engineers; purchasing, inventory, shipping and receiving; and, accounting personnel. These employees can be interviewed to determine how the processes are run; what types of raw materials, cleaning agents, lubricants, etc. are used; what types of waste are generated and how it is handled; what other types of records are kept; and what information is not recorded on a regular basis. When gathering this information, begin to track wastes to determine if there are seasonal or shift variations in wastes generated. Once this information is assembled, the general process can be characterized.

Define Production Units

To compare the amounts of waste generated during different time periods, and subsequently measure relative waste reductions, a production unit should be defined for each process – either the unit process or the overall process depending on the nature of the facility. A production unit is simply a set quantity of product characteristic of the process – tons of plastic, gallons of acid, number of copies, etc.

Once the production unit is defined, wastes generated can be quantified as waste per production unit. Since total production can vary, comparing the total amounts of waste generated for different time periods will not reflect the reductions achieved due to pollution prevention activities (i.e., waste will increase or decrease with production changes). For example, a printing press may use 1000 copies for a production unit and might then define wastes as 'waste per 1000 copies.'

By assembling background information, process flow diagrams for both the general process and individual processes can be developed. These diagrams, along with the material balances, help provide an understanding of the processes and the wastes generated. The pro-

Information On:	From:	
Raw Materials Use	Purchasing Records Inventory Records MSDSs Vendor Information	Production logs Packaging Material Discarded Shipping and Receiving Logs Annual Report
Waste Generated	Waste Manifests TRI data Sewer Records (POTWs) Permits/applications Flow diagrams Annual Report Rejected Product	Environmental Reporting Waste collection and storage Production Logs Environmental violations Laboratory analyses Obsolete expired stock Spill & leak reports
Production Mechanisms	Operations manuals (SOPs) Vendor information Control diagrams Quality control guidebook	Production logs Flow diagrams Product specifications
Process Interrelationships	Product-to-raw material data Flow diagrams Quality control data Dependencies on preceding processes (e.g., how change in one affects another)	Production logs Product specifications Facility layout
Economic Information	Cost accounting reports Operating costs for waste handling and disposal Costs for products, utilities, raw materials, labor	Pollution control costs

Table 4. Possible Sources of Background Information

duction unit can be used for waste reduction comparisons throughout the pollution prevention program.

Characterize General Process

A typical process has raw material inputs, product outputs, and waste generation. It can be represented by a general process flow diagram. This diagram may not physically resemble the process but will show the movement of raw material through the process as well as the generation of final product and waste. A simple diagram (Fig. 3) of a metal parts fabrication facility illustrates this.

In addition to the raw material, final product, and waste flows, other inputs can be represented on the general flow diagram such as lubrication fluids, cleaning agents, cooling water, etc. This will provide an understanding of the overall process and the associated wastes. The general process can then be separated into individual or unit processes.

Understand Unit Processes

Most production operations can be subdivided into a series of unit processes. For example, the general process of metal parts fabrication can be represented by at least seven individual processes.

1. Receiving and storing bulk metal
2. Cutting, bending, or shaping metal
3. Cleaning metal
4. Painting or coating metal
5. Assembling parts
6. Packaging
7. Shipping of assembled parts

Each unit process has its own inputs and outputs; the product from one step becomes the input material for the following step. The

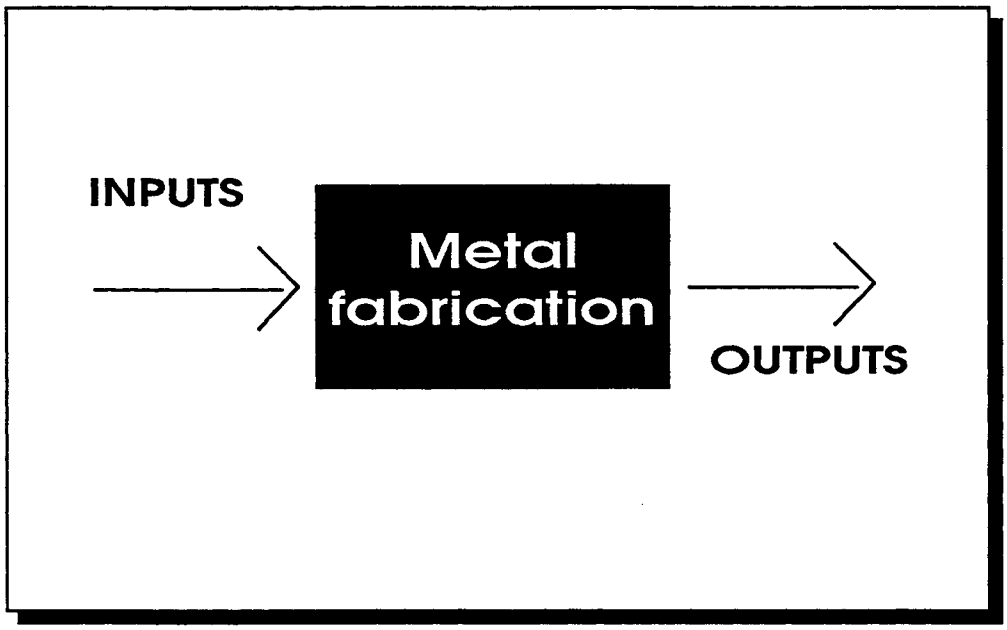

Fig. 3: A simple flow diagram

raw materials, products, and wastes for each unit process can be shown on a more detailed flow diagram. This diagram should contain the type/composition and quantity of raw materials, products, and wastes to all media. The diagram should also include other inputs (lubrication fluids, cooling water, cleaning agents, etc.) along with the quantities used. The background information obtained previously will be helpful to determine the types/compositions and quantities of these streams. The subdivision of the general process of metal parts fabrication is illustrated in Fig. 4. (no recycle of any material).

The flow diagrams for the unit processes (and in some cases the general process) can be completed using either of the two approaches: 1) start with the wastes and products generated and then determine the sources of the waste by going backwards through each of the unit processes, or 2) start with the raw materials and track them through each of the unit processes until products and waste material are generated. For cases where waste streams are not separated but rather are combined prior to handling, the second method may be the preferred initial approach. The two methods may also be combined to complete the unit process flow diagrams and thus a detailed overall process diagram.

It is critical to determine the types/compositions and quantities of raw materials consumed, product yield, and wastes generated as accurately as possible for each unit process. All wastes released to the environment (gas, liquid, and solid) should be characterized. These wastes can include: emissions from stacks; vent emissions from process areas; fugitive emissions from pipes, tanks, or vessels and leaking equipment; spent wash waters/cleaning solvents; cooling water; overspray from painting operations; cleaning rags; material scrap (e.g., metal, packaging, etc.); and other wastes. By subdividing the process into individual components, these types of wastes become more evident. With this information, a materials balance can be performed for the unit processes and then for the overall facility.

Perform Materials Balance

A materials balance accounts for all inputs and outputs into a process; in other words, what goes in must come out. A material balance should be performed for each unit process and for the overall production line. Although this typically is a very involved procedure, and while it is usually possible to identify sources of waste without having completed a materials balance, there are long term benefits to having done a materials balance. This

Metal Parts Fabrication

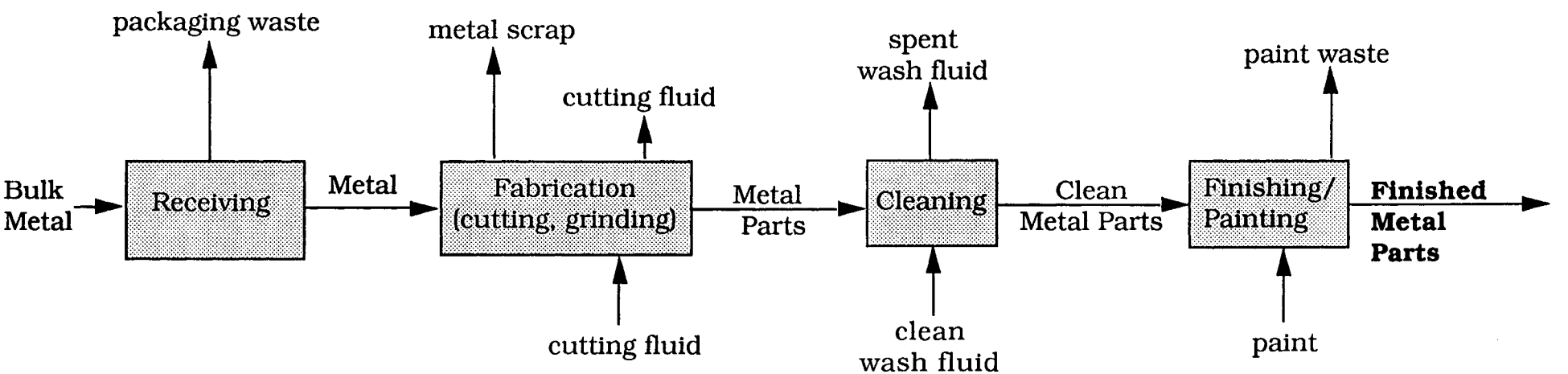

Fig. 4: Simplified general process flow diagram

material balance can help determine if fugitive losses are occurring in the process (e.g., fugitive loss from a solvent tank = difference between solvent in and solvent out). In a physical process, one in which there is no chemical change of materials, the raw materials that are not converted to product generally end up as waste. For example, a materials balance can be performed on the metal parts fabrication process as shown in Fig. 5.

For a chemical process, the materials balance becomes more complicated as raw material inputs are converted to products through one or more chemical reactions. Some unreacted raw materials may also end up as waste along with reaction by-products. For these processes, a standard material balance may already be available as part of the daily production log or cycle. Where possible, however, actual measurements of the amounts of materials used and generated should be used to produce the mass balance. The reason for this is that manufacturing processes can change over a period of time to a point where the actual materials balance would differ from that derived from the standard operating procedures.

Once the material balance has been performed, the actual amount of each waste generated by a process and the source becomes apparent if not already known. These numbers are the baseline amounts of total waste generated at the start of the pollution prevention assessment and can be used for comparison throughout the implementation of the program.

Key Elements of a Materials Balance

- Quantity of raw material brought on-site
- Quantity produced on-site including amounts produced as production by-product
- Quantity consumed on-site
- Quantity shipped off-site as, or in, product
- Total waste generation (before recycling and treatment)
- Amount of raw material in beginning and ending inventory
- An indicator of production levels involving the chemical
- Release and transfer rate

Table 5. Materials Balance

Metal Parts Fabrication

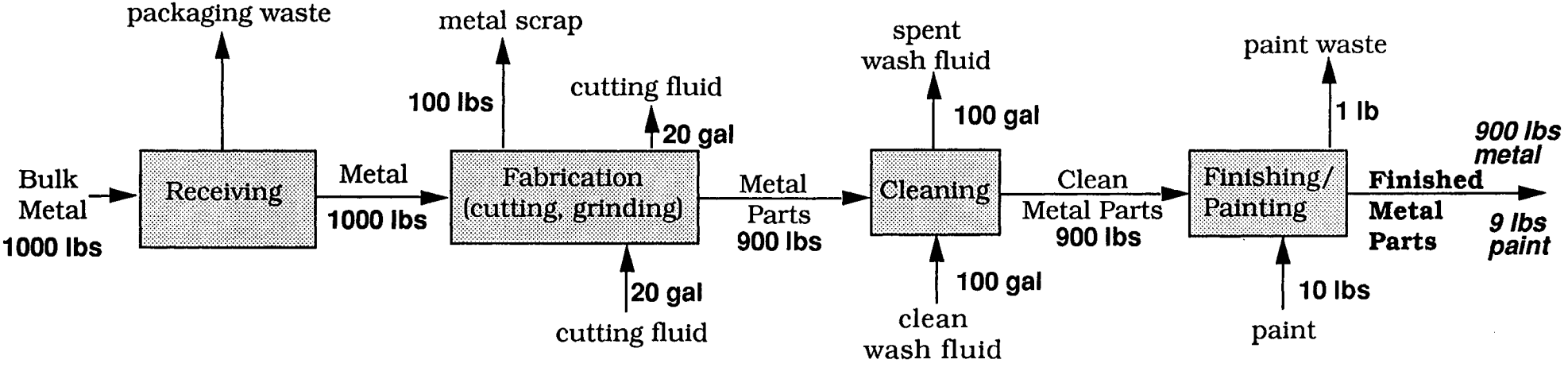

Fig. 5: Simplified materials balance for metal parts fabrication

ASSESSING WASTES AND IDENTIFYING POLLUTION PREVENTION OPPORTUNITIES 9

The information assembled in the process characterization will be used to help identify pollution prevention opportunities. This chapter provides guidelines for prioritizing streams and/or unit processes for beginning pollution prevention assessments in the facility (starting with the target streams), and for generating options for reduction using the information already obtained.

Prioritize Streams

Before conducting an assessment to identify what pollution prevention opportunities are present, waste streams and unit processes should be prioritized to determine which should be examined first. The flow diagrams prepared in Chapter 8 provide a good starting point for prioritization as they show all of the input and output streams for each unit process. Both the pollution prevention team and top management should be involved in this decision-making process since each will have their own ideas of what areas should be addressed initially.

When establishing priorities for pollution prevention, all of the input and output streams should be ranked – beginning with those which require immediate attention, followed by those which are less urgent. These factors should be considered when ranking the streams:

- US EPA's 17 target chemicals from the 33/50 program (see Chapter 15)
- Toxic Release Inventory (TRI) waste
- High purchase and/or disposal cost
- Highly toxic
- RCRA waste
- Particular regulatory concerns
- High use and/or release rate
- Potential for removing bottlenecks in production or waste treatment
- Potential liability due to endangerment of employees, environment or the public
- Potential for successful implementation
- High volume waste (may include tonnage)
- Carcinogens
- Hazardous Air Pollutants (HAP)
- CFCs and other future banned materials
- Local citizens' concerns

Once the streams are ranked, candidate input and output streams (especially wastestreams) can be identified, keeping in mind the goals set at the beginning of the program, for the initial pollution prevention assessment. As the assessment proceeds, these priorities may change.

Begin Assessments

When the candidate streams are established, the assessment for identifying specific pollution prevention opportunities can begin. This procedure involves first looking at the processes associated with the candidate streams and then expanding the assessment to the entire facility so that all potential opportunities are addressed. The pollution prevention team should discuss the potential waste streams and the staffing of the overall facility to determine who should conduct the initial process assessment. Typically a team of two to three people is effective.

The assessment team should first become familiar with the targeted processes. The flow diagrams developed in Chapter 8 provide an understanding of the process but may not explain why certain materials are used and why wastes are generated. For this information, the team must go into the facility and study the processes in detail. This study should be conducted while the process is in operation (ideally during all shifts) and, if possible, during a shut-down/clean-out/start-up period to identify what materials are used and wastes are generated by this procedure. When studying the process, the team should note any potential pollution prevention opportunities and

should pay particular attention to the following:

- Observe procedures of operation by line workers
- Quantities and concentrations of materials (especially wastes)
- Collection (including exact sources) and handling of waste (note if wastes are mixed)
- Any recordkeeping – and obtain copies of these if not already done
- Flow diagram - follow through actual process
- Leaking lines/poorly operating equipment
- Any spill residue
- Damaged containers
- Physical and chemical characteristics of the waste or release

It may also be helpful to photograph the process to recall specific details later. Often, details can be better captured visually than with words. However, this should be cleared with the appropriate personnel first.

The assessment team should talk with the line personnel, including operators, supervisors, and foremen, as much as possible. In doing so, they should determine the required operating conditions, product specifications, and equipment specifications for the process. They should discuss the points previously listed as well as the daily routine the workers follow. Specifically, the team should try to identify when waste is generated – not just by the regular process but by upsets, off-spec products, spills, etc. The team should also talk with the maintenance and housekeeping personnel who service the process to determine when, why, and how the process is serviced. Is preventive maintenance being done or are maintenance people always responding to breakdowns? It is important to talk with these individuals as they generally have the best working knowledge of the processes.

After examining the targeted processes, the assessment team should set a schedule for looking at the other processes in a similar manner. Assessment for non-targeted sources should be thorough, but it may take more time to completely assess these. Implementing pollution prevention projects on targeted processes can begin before assessments are completed for every process. This will help build momentum and corporate support for a sustained program.

The team should also conduct an overall survey of the facility. This survey consists of investigating supplemental operations such as shipping/receiving, purchasing, inventory, vehicle maintenance, waste handling/storage, laboratories, powerhouses/boilers, cooling towers, and maintenance. Again, the team should discuss daily routine with the personnel in these departments and should note potential opportunities for pollution prevention. Some specific topics to cover in these departments are listed in Table 6.

Once the process assessments and plant survey are completed, the data obtained should be reviewed for thoroughness by all of the pollution prevention team members. This review will also initiate the brainstorming process for ideas to reduce waste at the source.

Generate Reduction Options

A productive way to generate ideas is to conduct an informal meeting in which team members are encouraged to "brainstorm" and discuss options. The team members should also solicit ideas from other personnel at all levels – not only in their department but from the entire facility. Many times these personnel already have ideas for reducing waste but have never had the opportunity to express them. All options should be written down and given serious consideration.

Some of the options may be simple to identify and implement such as:

- Ship/receive materials in bulk to eliminate drum disposal if large quantities are used
- Reuse containers where possible
- Order materials "just in time" to avoid expiration
- Establish a central stockroom/ inventory control system
- Investigate solvent/cleaner alternatives or reducing the total number of different solvents used

Shipping/receiving	Packaging materials – what is done with waste? How are materials shipped/received – drums, bulk? Can containers be returned/recycled? Are you required to return empty containers to vendor? What happens to pallets?
Purchasing	Who orders materials? How far in advance are materials ordered? Can materials be ordered as needed (just-in-time)? Is the minimum amount ordered?
Inventory	What is the shelf-life of all materials? Is there an inventory control system? Bar coding? Is there a central stockroom (no individual orders)? Do you operate by "just-in-time" philosophy? Do you operate by "first in, first out" principle?
Vehicle maintenance	Are solvents used for parts cleaning? Are solvents recycled? Have solvent alternatives been tested? Do you recycle batteries, used oil, or antifreeze? How are used oil filters/carburetor cleaners handled?
Waste handling and storage	Are waste streams segregated? Do you know the sources of all waste? Do you have a "waste inventory" control system? How often is waste shipped off-site? Treated on-site? How is waste handled once shipped off-site?
Laboratories	How are chemicals ordered? In what quantities? What is the shelf-life of all chemicals? How are expired chemicals handled? Are solvents recycled/reused (e.g., first rinse)? How are gases stored? How are laboratory wastes handled? Are laboratory wastes segregated?
Powerhouse/boiler	How is fly ash/slag handled? How is tube clean-out material handled? What type of fuel is used? Are alternatives used? What type of boiler water treatment chemicals are used? How is boiler blow-down handled?
Cooling towers	What type of chemical additives are used? How is bottom sediment handled? What is your water source? Is water recycled?
Maintenance	What types of cleaners are used? Are solvents used? Are they recycled/reused? Have solvent/cleaner alternatives been tested? How are waste oil/greases handled? How are other wastes generated and handled?

Table 6. Topics to Cover in Assessing Support Departments

- Reuse solvents where possible
- Segregate waste streams

Other options that may not be as easily identified but must definitely be considered involve source reduction and in-process recycling. Table 7 provides some examples.

A priority approach in selecting options may be developed. Ranking options on a high, moderate, or low continuum helps to ensure that pollution prevention is not a "one-shot" approach. Moderate and low priority options should still be considered since circumstances such as a change in raw materials, regulations or technology could occur.

Once these options have been applied to specific streams/processes, further investigation or change in product composition may be required. For example, it may be necessary to implement new or existing techniques/technologies or to identify raw material alternatives. At this point it may be helpful to contact other facilities, vendors, trade associations, state and local environmental assistance agencies, and publications for ideas. These groups may be aware of material alternatives or similar pollution prevention technologies that have been successfully implemented. Further pollution prevention opportunities may be identified through "upstream" suppliers and "downstream" consumers. These individuals should also be allowed input into the company's program.

Another way to identify pollution prevention opportunities is through benchmarking. In the benchmarking process, a company selects an area for improvement and identifies other companies who have similar practices that they consider to be " best in class". They then compare their own practices to those companies' processes to determine where differences exist. The compay using benchmarking then implements measures to make their practices more like those of "best in class". A nine-step program developed by AT&T, benchmarking is described in detail in *Benchmarking: Focus on World Practices* (AT&T Quality Steering Committee, 1992). Working together, AT&T and Intel applied the benchmarking process to develop a pollution prevention program. Benchmarking teams from both companies followed the nine-step process to compare their own pollution prevention programs to the best in class programs of six other companies (Klafter, 1992).

Other waste management options may be considered after pollution prevention strategies have been exhausted. These include, in order of USEPA's priority, recycling on-site to other processes, reclamation, recycling off-site or using material exchanges, on-site treatment (physical, chemical, or biological process that renders a waste less toxic, produces a by-product that is recyclable or reduces the volumes of the waste stream for disposal), treatment off-site; and lastly, proper disposal. These alternative waste management options are discussed in more detail in Chapter 14. For additional sources of assistance refer to Chapter 15.

Source Reduction	In-process recycling
Substituting raw materials with less toxic alternatives Using raw materials that generate less waste Using raw materials that require less frequent cleaning of equipment Modify product to eliminate need for toxic materials Making process modifications and/or operating conditions that improve efficiency Improve preventative maintenance and operating procedures	Reuse of raw materials by fortification Reuse of raw materials by recovering from waste/product stream

Table 7. Source reduction and in-process recycling options

COST CONSIDERATIONS

10

Before pollution prevention projects are evaluated for economic feasibility, the full cost of waste generation must be determined. This full cost is necessary to develop the economics of pollution prevention techniques/technologies, including calculating the cost savings and payback periods. Methods for true cost determination and economic analysis are presented in this chapter. A cost accounting system for all wastes generated in the facility will also be described.

Determine Full Cost of Waste

The full cost of waste generation includes more than just treatment or disposal costs; it includes all the costs incurred by producing and handling waste. All of the expenditures associated with the waste stream, both direct and indirect, should be identified. These include, but are not limited to the following: purchasing, storage and inventory, and in-process use of materials; air and water emissions, solid waste collection, waste storage, on-site treatment or recycling; waste disposal; waste transportation; lost raw materials; and labor costs. A pie chart showing the typical cost for waste generation is shown below (Fig. 5). Often, wasted raw material costs are three-fourths of the full cost of generating waste. Waste disposal costs are typically less than half the total costs (Selman and Czarnecki, 1988). Many pollution prevention options will not appear to be justified if only half, or less, of the likely savings are considered. Some examples of waste associated costs to consider are presented in Table 8.

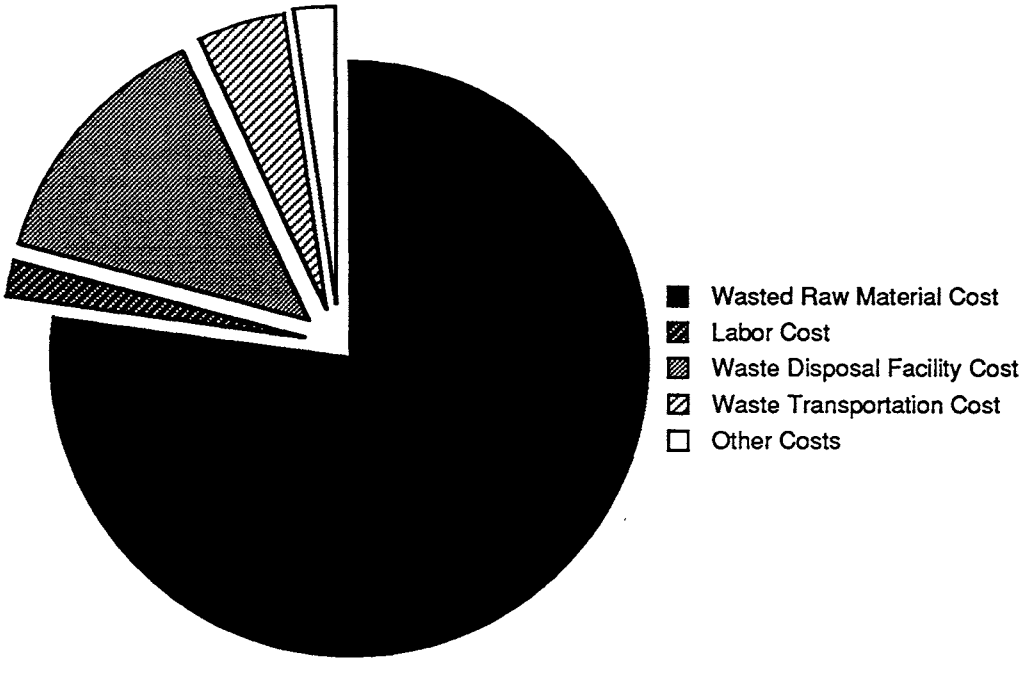

Fig. 5. Typical Cost Distribution for Waste Generation

TABLE 8. COSTS TO CONSIDER – DETERMINING FULL COSTS OF A WASTE STREAM

Hazardous Substance Use

Purchasing
- Taxes on hazardous products
- Safety training
- MSDS filing
- Safety equipment
- Extra insurance premiums
- Labor

Storage and Inventory
- Special storage facilities
- Safety equipment
- Storage area inspection and monitoring
- Storage container labeling
- Safety training
- Emergency response planning
- Spill containment equipment
- Lost product from spills, evaporation, etc.
- Labor
- SARA Title III (TRI) reporting

In-Process Use
- Safety training
- Safety equipment
- Containment facilities and equipment
- Clean-up supplies
- Labor

Lost Raw Materials
- Labor for handling
- Equipment for clean-up
- Reporting

Waste Generation

Air and Water Emissions
- Air emission permits and controls
- TRI measurements/estimates
- TRI reporting
- TRI fees
- Worker health monitoring
- Sewer discharge fees
- NPDES permits
- Water quality monitoring
- Sampling training
- Pretreatment equipment
- Pretreatment system operation

Solid Waste Collection
- Safety training
- Safety equipment
- Collection supplies
- Container labels
- Container labeling
- Recordkeeping
- Truck maintenance (for in-house fleet)

Waste Storage
- Storage permits
- Special storage facilities
- Spill containment equipment
- Emergency response planning
- Safety training
- Storage area inspection and monitoring

On-Site Treatment or Recycling
- Capital and operating costs
- Depreciation
- Utilities
- Operator Training
- Safety equipment
- Emergency response planning
- Permits
- Inspection and monitoring
- Insurance

Disposal
- Sewer fees
- Container manifesting
- Disposal vendor fees
- Preparation for transportation
- Transportation
- Insurance and liability
- Disposal site monitoring

Adapted from: Pollution Prevention Planning, Washington State Department of Ecology, Jan. 1992.

Develop Economics

Once the full costs of the waste streams are determined, an economic analysis of each specific pollution prevention project can be conducted. This analysis will provide management information on the costs and benefits associated with the techniques/technologies so they can decide whether it is economically feasible to proceed with implementation. Certain benefits, such as reduced long-term liability, reduced worker exposure to toxic chemicals, and improved community relations, will be difficult to quantify.

There are essentially two steps in an economic analysis after the true cost of waste generation have been determined: calculate the initial cost of implementing the pollution prevention strategy, and determine the annual cost savings and payback period (if applicable) for the project. In some cases, the total operating costs (including the waste handling costs) for the existing process and the 'new' process must be considered if they are substantially different. For example, some pollution prevention options involve increased utilities usage which must be taken into account.

The initial cost of the implemented technique/technology should include capital requirements for new equipment, start-up costs, training costs for new equipment or procedures, and any costs for regulatory compliance. The full cost for waste generation should also be calculated for the new option using the procedure described previously in this chapter. The strategy in question may have only limited initial costs associated with it, such as capital and start-up expenditures, since it may be as simple as a raw material substitution or making a minor process modification. In these cases, the annual waste cost savings may be the principle factor considered. However, there may be costs associated with implementation of the pollution prevention project such as process down-time or upsets. An additional source to consult for in-depth coverage, worksheets, and resources on pollution prevention is *EPA's Facility Pollution Prevention Guide (1992).*

Once the total initial cost for implementing the pollution prevention strategy is determined, the cost savings should be determined. To calculate this, the following equation may be used:

Existing full cost of waste - projected full costs of waste after implementation=cost savings

For options which do not involve capital investments or other initial expenditures, waste handling cost savings may be the primary consideration for economic feasibility. For most pollution prevention options, some costs will be reduced if the full costs for waste generation are identified.

For strategies that involve initial expenditures, such as capital investments and start-up costs, each company will have its own criteria of feasibility to consider. It will usually be necessary to calculate the economics of a project by methods specifically determined and approved by the company.

A quick test for initial feasibility is the payback period. Additional methods of determining long-term costs include net present value, internal rate of return, and profitability index. Further information on applying these methods can be found in EPA's *Total Cost Assessment: Accelerating Industrial Pollution Prevention through Innovative Project Financial Analysis* (1992). The payback period is defined as the amount of time (generally expressed in years) it takes to recover the initial investment through annual cost savings. The following equation can be used as a simple calculation of the payback period. Note that this equation does not account for depreciation, interest, etc. A very thorough and in-depth examination of full cost accounting can be found in Appendix F of US EPA's *Facility Pollution Prevention Manual.*

$$\text{Simplified Payback Period} = \frac{\text{initial investment (capital + start-up + other costs)}}{\text{annual full waste handling cost savings}}$$

In options where there is a substantial difference in the total operating costs of the existing process and the "new" process (e.g., utilities usage increases significantly), the total annual operating cost savings (including waste handling cost savings) should be used in place of the annual true waste handling when calculating the payback period.

Establish Cost Allocation System

A cost allocation system is an important element of a pollution prevention program. In this system, each department or process is charged for the total waste management costs for the wastes they generate. The charges should cover the full cost of the waste as explained previously in this chapter. This cost allocation system should lower the total overhead cost as most companies charge waste disposal costs to overhead (i.e., the environmental department). It will also provide incentives for employees associated with the departments/processes that are charged for the waste handling to reduce their waste generation and subsequently their costs.

By calculating the full cost of waste generation, the parameters for determining the economic feasibility of pollution prevention strategies can be developed – annual cost savings and payback period. These will be used in the following chapter to evaluate the pollution prevention options and to decide which option could be implemented first. Establishing a cost allocation system will provide employees, including management, with a better awareness of the costs associated with waste generation in their department/process.

IDENTIFYING AND IMPLEMENTING POLLUTION PREVENTION PROJECTS

11

Once suggestions for pollution prevention options are gathered and the costs associated with these options calculated, they should be reviewed by the pollution prevention team and the least beneficial options eliminated from further consideration. These options may be reviewed again at a later time since pollution prevention is a continuous process and what is less beneficial now may work better in the future. The remaining options should then be examined in more detail to determine its overall benefits. Technical and economic feasibility of each option, based on the company's requirements for these criteria, should be studied. For example, each company has their own standards for economic evaluation, feasibility for implementation, levels of expertise, operational requirements, etc. Those options found to be consistent with the company's goals can then be scheduled for implementation. There may even be cases in which certain benefits of a project override low economic return.

Benefits

The benefits to be gained by implementing a pollution prevention project should be identified. Along with reduced waste generation (and associated costs), these benefits may include improved worker safety/morale, better community relations, reduced liability, reduced regulatory concerns, and improved relations with regulatory agencies. These benefits may be difficult to quantify but should be emphasized when evaluating options for implementation approval.

Technical Evaluation

There are many factors which should be considered when determining if a project is technically feasible. Table 9 presents some of these factors.

Personnel that will be directly affected by implementing the project should be consulted and included in the decision-making process. They typically have knowledge of process details that may inhibit the project success and are essential in proper implementation. For projects that involve a new technology/technique, a bench-scale or pilot test may be required to assess the technical feasibility. At this point, if it is determined that an option is not feasible by these criteria, the option should be deferred for consideration at a later time when the circumstance for evaluation may be different. If possible, illustrate effects of an option by modifying flow diagrams of existing processes to show how potential options will improve plant processes.

Process related	Company related
Exisiting technology available	Pollution prevention goals
Amount of downtime required	Product quality maintained
Equipment/procedure compatability	Customer acceptance of product
Utility requirements/availability	Likelihood of success
Specific training required	Creation of other environmental concerns
Acceptable service from vendor	Reduction of treatment/disposal costs
Ease of implementation	Payback period
Quality assurance	Regulatory compliance costs
	New markets for modified products

Table 9. Factors to consider in determining feasibility

Economic Evaluation

Once a pollution prevention project has been found to be technically feasible, the economics of the project should be examined. In the previous chapter, the full cost of waste generation and the cost savings for implementing a pollution prevention option was determined. In cases which involve capital and start-up expenditures, the payback period or other economic criteria were calculated. This information is necessary when evaluating the economic feasibility of a project.

Any project that yields a cost savings (annual waste handling or annual operating costs) has potential for profitability. If there are no initial costs involved, then a project can be considered economically feasible if there is a cost savings. Options such as better operating practices may be the most practical to implement first since they do not require an initial capital investment.

For projects with capital and start-up costs, an additional profitability criterion must be examined: payback period and other economic criteria (as calculated in Chapter 10). Typically, if the payback period is less than five years, the project may be considered economically feasible. This criteria varies depending on the company. There may also be other profitability measures that must be considered; this, too, will depend on the company. Before making the final economic feasibility determination, the accounting department/controller should be consulted since his/her approval will usually be necessary before the project may proceed.

At this point, there may be more than one project that meets the company's goals for pollution prevention (i.e., beneficial and feasible).

Implementing Projects

Once the pollution prevention team selects the projects to be implemented, management approval must be obtained. If management support was obtained as described in Chapter 6, the approval process should not be difficult (providing the project benefits, profitability, and feasibility are acceptable). The pollution prevention coordinator (or whoever will be in charge of the project) should present to management the details of the project along with the budget and project justification (particularly economics). Individual companies will have their own procedures to be followed for project endorsement.

When approval has been obtained, the necessary funding for the project should be acquired. Again, this procedure will vary with the company. It may be worthwhile to contact the Illinois Department of Commerce and Community Affairs (DCCA), the Federal Small Business Administration, and other governmental offices; these organizations may provide loans or grants for pollution prevention projects.

When funding is in place, project implementation can begin. The phases of implementation will be the same as for most other projects in the company. Personnel that will be directly affected by the project (line workers, engineers) should be involved from the start. Those personnel indirectly affected (e.g., controllers, purchasing agents) should also be involved as project implementation proceeds. Any additional training requirements should be identified and arrangements made for instruction. All employees should be periodically informed of the project status and should be educated as to the benefits of the project to them and to the company. Encourage employees to comment on the plan and to suggest additional reduction options. This may ease the natural resistance to change.

PROGRAM AND PROJECT EVALUATION

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Once a pollution prevention program is established it should be continuously evaluated and updated. This periodic review by the pollution prevention team should be conducted for all stages of the program, from management support and team selection to project implementation. Once the elements have been examined, the program can be modified and goals redefined to improve overall effectiveness.

Program Evaluation

The progress of the pollution prevention program can be determined by looking at the individual activities and projects. One way of measuring progress is quantitative. For example, look at actual waste reduction, both in terms of actual change in quantity and change in hazard level. The actual change in quantity is the difference between the waste per production unit reported in the current year and the waste per production unit reported in the previous year. The change in hazard level is based on toxicity, reactivity, ignitability, and corrosivity of the waste and industrial hygiene/employee exposure-type measurements. This comparison measurement is most useful when evaluating an alternative material substitution such as switching from an organic solvent to a water-based solvent (switching to water may even eliminate an OSHA sampling requirement -- DO WE WANT THIS?). These measures of waste reduction may not be appropriate for all facilities and wastes. Other quantitative measurements are adjusted quantity change and throughput ratio. Additional guidelines and detailed descriptions on measuring waste reduction can be found in Chapter 4 of EPA's *Facility Pollution Prevention Manual*, and in *Alternatives for Measuring Hazardous Waste Reduction* by R. Baker, R. Dunford, and J. Warren (available from HWRIC).

Progress can also be measured qualitatively through employee involvement, attitude and number of ideas suggested. Some examples of qualitative evaluation criteria are presented in Table 11.

When evaluating the elements of the program, it is important to identify those strategies and techniques which have been very successful, marginally successful, or have failed. If possible, the reasons why these projects were or were not successful should be determined. This information will be beneficial for modifying the program and redefining goals.

Program Modification

To ensure continuing progress and success of the pollution prevention program, the individual components and the overall plan should be modified using the knowledge gained from experience. Successful strategies and techniques can be used again or adapted to other areas where progress has been slow or impeded. The initial pollution prevention goals should be redefined and/or expanded, reaching for the ultimate goal of zero waste generation.

Project Element	Evaluation Criteria
Management Support	Statements of support Approval of projects Providing ideas/input Praise and publicity of successes
Team aspects/program initiation	Employee enthusiasm & participation Using skills from training Supporting projects Providing ideas
Understanding process	Processes characterized Flow diagrams developed All wastes and sources identified Waste accounting system implemented
Project implementation	Projects completed within budget Projects completed on schedule Waste reduction achieved Cost savings attained Raw material savings achieved Product quality improved Worker safety improved Cost allocation system implemented
Continuing the program	Follow-up and review procedures established Employees kept informed and involved Pollution prevention team composition rotated

Table 10. Program Evaluation Criteria

SUSTAIN THE POLLUTION PREVENTION PROGRAM

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Now that a pollution prevention program is underway, it must be sustained in future years. This involves reaffirming commitment to the program at all levels – including upper management. Employee enthusiasm and interest must be maintained to ensure continuation of the program. Ideally, the entire eight-step cycle should be repeated following the successful implementation of each pollution prevention project. Some specific ideas for sustaining the program include bringing new personnel into the pollution prevention team, training, and publicizing success stories.

Rotate Pollution Prevention Team

To maintain the flow of fresh ideas, the pollution prevention team members should be rotated to introduce new perspectives. With an ongoing pollution prevention progam, there may be new employees who join the company over the years that want to participate. A new team leader may step in with high energy, enthusiasm, and creativity. If some members do step down, they can serve as consultants to the new team. There may also be dedicated team members who wish to remain on the team; this should be encouraged as they have gained valuable experience. The composition of the team should still include employees from all levels and departments. The importance of a written pollution prevention plan is that it will outline the operating procedures for the program and provide continuity even when team members are replaced.

Refresher Training

Pollution prevention awareness and training should be conducted on a periodic basis so that all new or reassigned employees understand the company's committment to pollution prevention. Pollution prevention training should be incorporated into a number of the companies existing training programs (Health and Safety, Environmental, Processes, etc.). This training should be an on-going process.

Publicize Success Stories

Publicity is one of the most effective means to sustain the pollution prevention program. Internal publicity raises the awareness of employees of activities going on at the facility and encourages further participation. The results of the various projects should be relayed through bulletin boards, newsletters, interoffice memos, etc. The names of the pollution prevention team members, as well as those employees offering suggestions, should be included in these publications. If individual successes are recognized, other employees may wish to join in to receive the same recognition. Presentation ceremonies for employee/team incentive awards will also help publicize successes. Cost savings, waste reductions, and product quality improvements due to pollution prevention activities/projects should be highlighted.

The pollution prevention program can be a key public relations tool. Any reduction in waste is a benefit to employees, the community and the environment and should be publicized. News releases should be prepared for local and state media documenting the project and the benefits gained by the company and the surrounding community. Reporters could also be invited into the facility for a demonstration of a new technology.

Further public recognition can be facilitated through state, county, and local award programs. The state of Illinois sponsors the Governor's Pollution Prevention Awards each year. These awards are presented to industrial facilities, trade organizations, vendors, community groups, and educational institutions that demonstrate significant achievements in pollution prevention. Some cities and counties also hold similar recognition programs.

Trade association meetings and publications are another good avenue for promoting a company's pollution prevention program. Case studies can be submitted which demonstrate the company's progressive stance in environ-

mental protection while describing the use of innovative technologies and techniques to reduce waste. These case studies should emphasize the benefits gained by the company – not only waste reduction but also cost savings, quality improvements, safety improvements, regulatory compliance and better community relations. Applying for state or national pollution prevention awards can also be a means to publicize the company's efforts.

OTHER WASTE MANAGEMENT OPTIONS

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As described in Chapter 4, it is federal and state policy that pollution be prevented or reduced at the source whenever feasible. Despite the tremendous progress some have made in preventing wastes, it is often not economically or technically feasible to eliminate all wastes from industrial processes. For any remaining wastes the preferred management options in order of preference, as shown in Table 11, are on-site recycling or reuse, off-site recycling or reuse, treatment including destruction by incineration and other means, and disposal in landfills. This is commonly referred to as the waste management hierarchy. EPA has taken the position that the hierarchy should be viewed as establishing a set of preferences, rather than an absolute judgement that prevention is always the most desirable option.

For safety or economy-of-scale reasons in some specific situations recycling or treatment may be preferable to source reduction or in-process recycling. Environmentally sound recycling can have many of the advantages of source reduction because it achieves reduction in the amount of wastes needing treatment or disposal and conserves energy and other resources. However, on-site recycling and treatment are generally preferred over off-site processing because releases often occur during transport and handling and the chances for spills increase.

Some facilities lack the skills to operate recycling or treatment equipment properly. The permitting process required for an on-site waste treatment facility is both time consuming and expensive as it involves a public hearing. Others do not generate a large enough quantity of waste for economic operation of recycling equipment. In those cases, off-site recycling or treatment where wastes from multiple facilities are combined can be an excellent waste management approach.

Other technologies that do not in themselves reduce the mass of contaminants produced also may be beneficial. For example, more efficient use of water in plating rinsing through use of counter-current flow or spray rinse systems increase the cost effectiveness of in-process metal recovery and reuse.

The emphasis in managing waste should be to continually try to move up the hierarchy toward source reduction and waste elimination (pollution prevention). Although a company may have an environmentally sound recycling program for certain wastes, the generation of these wastes may reflect inefficiencies in operation. Obviously, if more of these wastes can be turned into product, the company will decrease its costs and should increase profits.

In summary, source reduction techniques and in-process recycling which prevent and reduce waste generation are preferred over recycling, treatment, and disposal options that deal with wastes after they are produced. Once pollution prevention options have been fully considered, additional methods of handling and controlling wastes should be evaluated according to the waste management hierarchy. Often these approaches need to be used in combination to be most effective. Technical advancements in production processes and waste management technologies make it desirable for each company to routinely review and improve its pollution prevention and waste management practices.

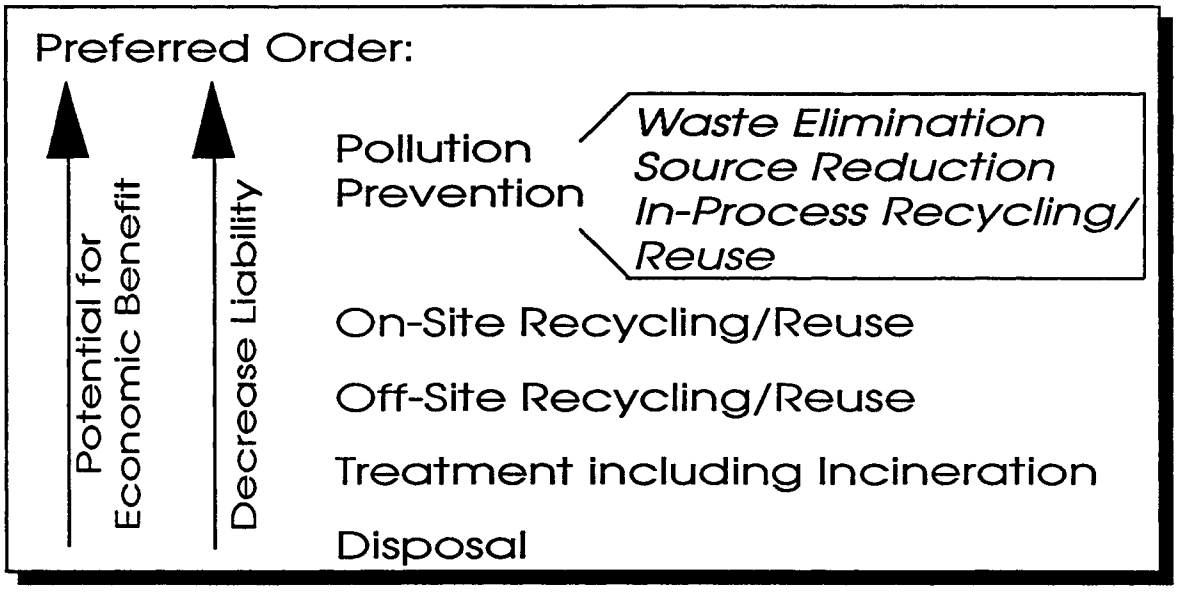

Table 11. Heirarchy of Waste Management Options

ADDITIONAL SOURCES OF POLLUTION PREVENTION INFORMATION 15

Hazardous Waste Research and Information Center (HWRIC)

The Hazardous Waste Research and Information Center, located in Champaign, Ill., was established in 1984 as a division of the Illinois Department of Energy and Natural Resources. HWRIC is a non-regulatory agency which combines research, information collection and analysis to provide Illinois citizens, businesses, and other organizations with direct technical assistance and literature on matters of pollution prevention and waste management.

The Center's five programs include Research, Information Services, Laboratory Services, Pollution Prevention and Data Management.

RESEARCH

HWRIC supports a balance of basic and applied research by investigators from public and private universities, industry and other government agencies. The funding HWRIC provides to these researchers is often supplemented by other funding sources. Three areas of emphasis for the research program include: 1) promotion of pollution prevention technologies and techniques; 2) development and evaluation of remediation technologies; and 3) assessment of the threat contaminants pose to the environment and human health.

INFORMATION SERVICES PROGRAM

HWRIC's library and clearinghouse provide a wide range of books, reports, articles, and pamphlets on hazardous waste, pollution prevention and waste management topics. Database search capabilities are also available.

LABORATORY SERVICES

The Laboratory Services program provides coordination and support of research activities in the laboratory wing and analytical support to researchers needing assistance.

POLLUTION PREVENTION

The pollution prevention program is central to HWRIC's efforts to help Illinois industries better manage their waste. Illinois businesses, educational institutions, governmental bodies, communities and citizens who request assistance with waste management, pollution prevention and other environmental problems are helped in various ways by HWRIC's technical assistance staff. This may include on-site technical assistance including help in developing a pollution prevention program and written plan. HWRIC also administers the Governor's Pollution Prevention Awards to recognize successful pollution prevention efforts of Illinois industrial facilities, vendors, trade organizations, community groups, and educational institutions.

DATA MANAGEMENT

HWRIC staff maintain databases on current locations, quantities, properties and components of hazardous materials and waste.

For assistance from HWRIC contact:
HWRIC
1 East Hazelwood Drive
Champaign, Illinois 61820
(217) 333-8940
FAX: (217) 333-8944

Illinois Environmental Protection Agency (IEPA)

The Illinois Environmental Protection Agency is a regulatory arm of state government which enforces state and federal environmental protection mandates.

OFFICE OF POLLUTION PREVENTION

IEPA's Office of Pollution Prevention (OPP) promotes a spirit of cooperation between government and undustry through the Partners in Pollution Prevention (PIPP) Program. Partner companies receive expedited permits for pollution prevention projects and an enhanced "Good Neighbor" community image. Companies must first designate a pollution prevention facilitator and adopt a policy statement with management support then design their own programs and schedules for implementation. Under the Toxic Pollution Prevention Act, IEPA provides variance support for innovation plans.

For more information contact:
Office of Pollution Prevention
Illinois EPA #34
P.O. Box 19276
Springfield, IL 62794-9276
(217) 782-8700

POLLUTION PREVENTION INTERNSHIP PROGRAM

This program places engineering students as interns at Illinois industries on targeted pollution prevention projects. Interns receive training and technical support from OPP support staff. They report and work at the cooperating industry under that company's direct supervision. Pollution prevention goals are mutually determined and company confidentiality requirements are respected. The program has saved Illinois industries over $2 million to date.

ILLINOIS INDUSTRIAL MATERIALS EXCHANGE SERVICE (IMES)

IMES is operated by IEPA in cooperation with the Illinois State Chamber of Commerce. It is an information clearinghouse, directory, and marketing facilitator for hazardous and nonhazardous materials that might otherwise be wasted. Information about materials either wanted or available is submitted to IMES and published and distributed without charge to more than 13,000 subscribers nation-wide. At no time is IMES involved in negotiations or actual exchange of materials. Client confidentiality is respected at all times. IMES in now part of the National Materials Exchange Network.

For more information contact:
Industrial Materials Exchange Service
Illinois EPA
2200 Churchill Rd., #34
P.O. Box 19276
Springfield, IL 62794-9276

Department of Commerce and Community Affairs (DCCA)

As a result of the Clean Air Act Amendments of 1990, each state is required to provide a Small Business Assistance Program. DCCA will operate this program. The purpose of the program is to provide compliance information to small businesses. This includes their rights and obligations to meet the requirements under the Act. Additional information must also be provided in the areas of pollution prevention, accidental release detection, process technologies available and a referral system for assistance.

For more information contact:
Dept. of Commerce and Commnity Affaris
Environmental Assistance Program
620 E. Adams St.
Springfield, Illinois 62701
(217) 524-0169
(217) 524-6591

United States Environmental Protection Agency (USEPA)

POLLUTION PREVENTION INFORMATION CLEARINGHOUSE (PPIC)

USEPA'S PPIC was established in 1988 to promote source reduction and recycling through information exchange and technology transfer. The PPIC is a free clearinghouse service containing technical, policy, programmatic, and legislative information relating to pollution prevention and recycling. The PPIC utilizes the following information exchange

mechanisms: a repository containing the most current pollution prevention literature, such as case studies, fact sheets, training, videotapes, and general references; Pollution Prevention Information Exchange System (described below); hotlines to answer or refer questions and to provide links to PIES for users without access to a PC; and, outreach efforts including workshops, training, and industry-specific pollution prevention materials. For more information contact: PPIC, c/o SAIC, 7600-A Leesburg Pike, Falls Church, VA 22043 (703) 821-4800 or FAX (703) 821-4775.

The USEPA publishes a document each year which provides information on pollution prevention resources available from both federal and state agencies. It includes listings of documents, videos, state and university programs, USEPA resources, libraries, and clearinghouses. Entitled *Pollution Prevention Resources and Training Opportunities in 1993* (EPA/560/8-92-002), this document is available from USEPA PPIC.

POLLUTION PREVENTION INFORMATION EXCHANGE SYSTEM (PIES)

PIES is an electronic conduit to information and databases, as well as a national and international network. It is PC accessible without user fees, easy to use, open 24 hours a day, technically and policy oriented. PPIES helps: access technical and programmatic information; solve technical and policy questions; find and order documents; locate expert assistance; identify upcoming pollution prevention activities and events in your area; discover grants and project funding opportunities; save money by showing you how to reduce your waste and reduce liabilities. For more information, contact the Pollution Prevention Information Clearinghouse or refer to *The Pollution Prevention Information Exchange System (PIES) User Guide* (EPA/600/R-92-213; Nov. 1992)

THE 33/50 PROGRAM

The 33/50 program is EPA's voluntary pollution prevention initiative to reduce national pollution releases and off-site transfers of 17 toxic chemicals by 33 percent by the end of 1992 and 50 percent by the end of 1995. EPA is asking companies to examine their own industrial processes to identify and implement cost-effective pollution prevention practices for these chemicals. Company participation in the 33/50 program is completely voluntary. The Toxics Release Inventory (TRI) will be used to track these reduction using 1988 data as a baseline. As required by the Pollution Prevention Act of 1990, TRI industrial reporting requirements will be expanded, beginning in calendar year 1991, to include information on pollution prevention.

The 17 chemical groups are:
benzene
cadmium & cadmium compounds
carbon tetrachloride
chloroform
chromium & chromium compounds
cyanide & cyanide compounds
lead & lead compounds
mercury & mercury compounds
methylene chloride
methyl ethyl ketone
methyl isobutyl ketone
nickel & nickel compounds
tetrachloroethylene
toluene
1,1,1-trichloroethane
trichlorethylene
xylenes

For more information, contact TSCA Hotline (202) 554-1404 or FAX request to TSCA Assistance Services (202) 554-5603. You can also access 33/50 mini-exchange on PIES or contact USEPA Region V, Pollution Prevention Coordinator, 77 West Jackson Blvd., Chicago, IL 60604-3590; (312) 353-4135, FAX (312) 886-5374.

THE GREEN LIGHTS PROGRAM

Green Lights is a voluntary, non-regulatory program sponsored by the USEPA to encourage companies to convert to more energy efficient lighting, and thus reduce pollution produced from energy generation (e.g., carbon monoxide, sulfur dioxide, nitrogen oxide emissions; scrubber waste; boiler ash, etc.) By switching to new lighting technologies, companies can also lower electric bills and improve lighting quality. The USEPA has also involved equipment vendors, electric utilities, and lighting management companies, called Green Lights Allies. These groups are encouraged to give rebates to those customers who use energy-efficient lighting. For more information contact PPIC or the Region V Pollution Prevention Coordinator.

APPENDIX

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Other Resources

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USEPA. 1993. *Pollution Prevention Resources and Training Opportunities in 1993.* EPA/560/8-92-002

POLLUTION PREVENTION PROGRAM CHECKLIST

Top Management Support

- ☐ Written policy statement supporting pollution prevention
  - ☐ Distribute statement to all employees

Getting Your Program Started

- ☐ Commit to implementation
- ☐ Designate a pollution prevention coordinator
- ☐ Develop a pollution prevention team
- ☐ Set goals
- ☐ Increase Employee Awareness
- ☐ Train employees
- ☐ Reward pollution prevention successes

Understanding Processes and Wastes

- ☐ Gathering background information
  - ☐ Raw materials
  - ☐ Production Mechanisms
  - ☐ Waste Generated
  - ☐ Process Interrelationships
- ☐ Characterize general process
- ☐ Examine unit processes
- ☐ Perform materials balance
- ☐ Define production unit

Identify Pollution Prevention Opportunities

- ☐ **Begin assessments**
- ☐ **Prioritize waste streams**
- ☐ **Generate reduction options**

Cost Considerations

- ☐ **Determine full cost of waste**
- ☐ **Develop economics**
- ☐ **Establish cost allocation system**

Identifying and Implementing Pollution Prevention Projects

- ☐ **Determine benefits**
- ☐ **Conduct technical evaluation**
- ☐ **Conduct economic evaluation**

Program and Project Evaluation

- ☐ **Evaluate program**
- ☐ **Modify program as needed**
- ☐ **Determine methods to measure waste reduction**

Sustain the Pollution Prevention Program

- ☐ **Rotate pollution prevention team**
- ☐ **Train employees as needed**
- ☐ **Publicize success stories**

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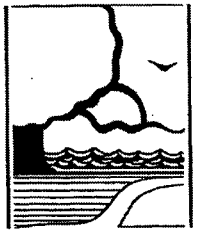
Division of the Illinois
Department of Natural Resources



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